Reference Field Monitoring (RFM)
An Approach for Institutionalizing IPM
in Processing Tomatoes

<u>To: California Department of Pesticide Regulation - 1996 First Year Report</u>

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2. **Project Title**

IPM Reference Field Monitoring (RFM) for Processing Tomatoes

3. **Executive Summary**

BIRC's "Reference Field Monitoring" (RFM) helps growers make decisions about pesticide use based on actual pest and natural enemy prevalence. RFM builds upon, adapts, and synthesizes sampling and reporting methodologies and biologically intensive IPM strategies developed collaboratively with extension Agents, and UC, Davis and Campbell Soup researchers. The goal is to develop a practical, state-of-the-art approach that can cost-effectively institutionalize IPM strategies thereby reducing unnecessary pesticide use and simultaneously introduce innovative least toxic pest controls.

The project experienced the highest grower participation to date and the highest distribution of its mailing list. Data on late season insect pests (the potato aphid, stinkbugs and worms) were collected from 16 growers, and over 50 fields covering over 3000 acres. The data collected constitutes a foundation for selecting applied research projects, the supporting evidence to show excessive premature treatments, and a baseline from which to evaluate further improvements to encourage the transition to Bio-IPM (Bio-Intensive IPM) and the reduction of highly hazardous pesticides.

<u>Seven out of 16 growers (44%)</u> attempted innovations that could lead to reduction in conventional pesticide use: a) on-farm tests of low risk products, Trilogy (a neem oil base) or BT (*Bacillus thuringiensis*), b) partial field treatments with conventional products compared to no-treatments, and c) increased tolerance levels based on recommended action levels, and d) compliance with project guidelines resulting in no treatment.

We used the same sampling protocol for every field comparing four (upper & lower leaf, 1 shake, and 1 tip) sampling methodologies (two are UC methods, one is Campbell Soup method, one is a BIRC method). Monitoring lasted 18 weeks starting June 1st and ending the second week of October. 67% of the fields grew the cultivar 3155 (2198 ac) and most were harvested on or about the 15th of September. 3155 is the most important cultivar being grown in CA. at this time. Yields of these 3155 fields varied from 9 to 35 tons/ac. (delivered), averaging 29 tons/ac. This average is based on 25 fields and 1328 ac. and is not appreciably different than the usual state-wide average of 32 tons/ac., particularly considering the yield-reducing effects of excessively high late summer temperatures.

4. Results and Discussion:
a. Summary of Phase II - 1996 Goals and Objectives

The overall goal of this project is to minimize pesticide use and losses due to pests by implementing biologically intensive IPM programs within the processing tomato industry throughout the state. The initial phase (1993-95) developed the basic "Reference Field Monitoring" methodology for achieving this goal grew to involve 12 cooperating growers and their PCAs. Phase II (1996-98) is designed to expand the number of cooperating growers and PCAs, to further refine sampling methods, evaluate guidelines for decision-making and evaluate alternative insecticides. Phase I findings are summarized in an IPM Practitioner article [18(4):1-13 (see attachments)].

The following objectives have been established for Phase II. The principle results are presented in Tables 1-3 and are discussed below under the appropriate objectives.

Objective 1: Expand the number of growers participating in the RFM program to 24, increase the participating acreage to 2400 acres, and distribute the weekly data summaries from the "Reference Fields" to 300 processing tomato growers and 50 key stakeholders in university and private settings;

Objective 2: Further refine, evaluate and apply field monitoring techniques, data collection methods, and action levels for late season potato aphids, armyworms, and stinkbugs;

Objective 3: Conduct on-farm field tests of techniques to reduce the use of toxic materials on processing tomatoes, specifically:

a. Low-toxic selective insecticides and application methods for aphids;

b. Low-toxic selective insecticides and application methods for armyworms:

b. Results from the 1996 Season:

<u>Objective 1.</u> Expansion of the IPM tomato program to more growers and distribute weekly Reference Field Monitoring Report to a greater number of growers and other stakeholders.

<u>Objective 1:</u> a) Expanding Grower Participation: We started the 1996 season working with 18 growers and monitoring 80 fields of processing tomatoes amounting to well over 3,000 acres. Although we hoped to work with twice as many growers in 1996 as in 1995, we shifted slightly just before June to include more acreage than the original objective called for but fewer growers. Growers familiar with the program from the prior years were more eager to offer greater acreage and required less educational work to bring up to date. New growers cautiously entered the project with one field each at about 40-50 ac. We also included more acreage from these latter growers producing other than the cultivar 3155, mostly 8892. Two growers who had been in the program previously initially told us they would not have late season tomatoes this season, but at the last moment came into the program with considerable acreage.

<u>Discussion:</u> We learned that working with growers who already had experiences with our work is more productive at this stage than trying to include many more new growers in the program. Some new growers are essential as they allow for program expansion and confirmation of working methods, particularly if they are willing to follow our guidelines and attempt some innovation. We decided it was more prudent however, to work out efficient monitoring and decision making methods, and overall operating procedures. Also, as travel time between growers fields is one of the main investments in running such a program, it is more logical to grow more intensively geographically rather than expand extensively at this phase.

<u>Objective 1:</u> b) Operation of field teams: To service a greater number of growers than in 1995 we needed to operate multiple field teams. We started the season with three teams of two people. Each team had an independent licensed Pest Control Advisor (PCA) and one scout (a potential PCA-in-training). The objective was that the trainee could later scout independently when more fully trained. Each team was to work two days per week each day covering 4 growers and at least 10 fields, or to monitor 20 fields per week, later dropping to an appropriate number.

After grower interviews, we found we had 80 fields offered to us which would have required the two teams to take on more fields. This proved to be more than our funding could support, and we paired down the number of growers to 16 and fields to just over 50. As the season progressed it became clear that existing PCA assistants were not adequate, although they were helpful. Near the end of the season most of the work was accomplished by two PCA's working more than full time. Total pest monitoring and reporting amounted to about 2500 hours.

Discussion: Because we entered the actual field season without all of our funds committed, we were unable to support the caliber of assistants we had initially hoped for. Some additional funds did come in later which allowed us to meet our commitments. During the field season less dedicated field staff dropped out from lack of physical stamina and general drive. We are excited by the pool of candidates who have responded to our recruitment efforts this spring. Skills, background, and interest in staying in the Central Valley are among the criteria we consider important.

In spite of initial promises from growers that the project would be notified when and where pesticide treatments were to take place, members of our team were sprayed by air directly on more than one occasion. There were also times when they learned, because of lack of notification, they had gone into sprayed fields before the recommended re-entry period was complete. This does not help with staff retention. We dropped two growers from the program as a consequence of these experiences.

We hope to also remedy lack of grower interest and reliability by better communications. The one field team with cellular phones was better at reaching growers while still in or near their fields. Each field team should have a cellular phone, but again funding was too limited in 1996 to accommodate this obvious need. Most growers have cellular phones and use them regularly during the critical parts of the season. Pagers were only partially useful, since there are no pay phones near growers' fields. The extra traveling to pay phones some distance away meant it was not possible to meet growers in the field at the time observations were critical.

Objective 1c: Expand the distribution of the weekly newsletter.
We provided each grower with an objective weekly monitoring report detailing the pest and beneficial counts on each field that we monitored each week at the same time. We also monitored right before a grower decided to spray to get pest counts, estimated percent of pest presence and size of beneficial insect populations. This information was summarized and compiled onto a single chart for inclusion in the weekly newsletter. We then distributed about 350 weekly "newsletters" to other growers and local stakeholders summarizing the monitoring reports and highlighting other items of importance - for example, trials with Trilogy, educational material regarding the life cycles of crop pests and beneficials, etc.. Six issues of this newsletter have been distributed (one copy of each were sent to DPR together with the quarterly reports).

Discussion: The newsletter was well received by growers judging by their responses to us. It needs to be improved by display of field data in graph format so time trends are discernible. It is important that growers learn that IPM programs differ from casual field checking by pesticide company representatives in basing decision-making on changes in pest and beneficial insect populations observed through regular monitoring. Also, we hope to group data from different geographical areas and then report time trends.

The newsletter is used to report on past experiences, program design and results of field trials of innovative, least-toxic, materials and application methods. We are also planning to present more information about natural enemies and IPM background along with information about other program possibilities (blackmold, reduced rate herbicide application methods).

Objective 2: Further refine, evaluate and apply field monitoring techniques, data collection methods, and action levels for late season potato aphids, armyworms, and stinkbugs.

Table 1 summarizes the late season information presented in detail in Table 2. This includes: the materials and material mixes used in the different treatments, the pests against which the material(s) are believed to be efficacious; the number of growers using each material or material mix after July 1; and the number of growers using the material while presumed target pests were below the projects action levels.

For example, the mixture of dimethoate and Asana® (= Cygon®/ esfenvalerate) was used 20 times (37%) and ideally is targeted at aphids and worms. Data obtained from growers fields just before treatment indicates our guidelines were followed only once out of these 20 treatments. The Asana® appears to be added to the dimethoate "for the ride". This is a PCA/grower phrase referring to decisions to add a second material to the first even though there is no immediate justification for the addition. The idea is to save money on later treatments and "prevent" a pest problem. We actively discourage this sort of thinking and are encouraged by the dimethoate-alone treatments.

Discussion: Dimethoate alone treatments for aphids were used 4 times. Adding the Dimethoate/Asana and the Dimethoate alone treatments gives 24 treatments (44%). Thus, almost half of all late season treatments are aimed at aphids. Similarly, Monitor® (methamidophos) and Monitor®/Asana® for stinkbugs constitute 17% (9/54). Although this analysis does not adequately show how important armyworms are to growers decision-making, the use of Asana® is aimed at these species and its use is larger than the stinkbug problem. It may be mostly unnecessary. Use of Bt would be the least toxic alternative that may be a substitute but more costly.

<u>Objective 2a)</u>: Grower Treatment Decisions:
Based on pesticides listed on grower submitted pesticide use reports analyzed above, the most important late season pest is the potato aphid, followed by worms, with stinkbugs last. Pesticide use reports are not currently required to indicated which pest the material was used against, something which we view as a major oversight. Any IPM program must identify the pest in order to learn about past research findings and to develop effective management strategies. Further, our observations indicate that most late season treatments are not based on field sampling and injury levels. Presumably the fields are scouted, but one can hardly consider such monitoring an IPM program. A statewide regulatory requirement to collect this information could provide a method to assess priorities for research to reduce unnecessary use of highly hazardous materials.

In spite of the competition between us and the traditional PCAs for grower attention, and initial suspicions regarding our motives, we did get 20% compliance with our recommendations during '96. In general treatments occur too soon and cannot be justified from the field sampling.

About 1/2 of the decisions following our guidelines required no treatments. The other 4 decisions conformed to our guidelines but used some type of innovation, e.g., using a single material and not a "cocktail", spraying half of a field, and in two cases alternative materials, Bt and Trilogy®, (see below). We feel these cases provides solid examples to our more conservative growers who did not comply with our guidelines.

<u>Discussion</u>: Most growers treat too soon for aphids. We observed treatments for aphids when aphid numbers were as low as 0.02 /leaf and 1.6% positive leaves (Tab. 2, field 15), for example. Our impression is that existing PCAs who are scouting fields recommend treatment when the first aphids are found. Growers who monitor their own fields frequently tolerate much higher aphid numbers even though they are not precise about actual samples and make no written records. No grower or PCA to our knowledge keeps written records of pest numbers, although all are required to comply with regulations to keep written records of pesticide use.

<u>Objective 2b:</u> Evaluation of decision-making guidelines: We are attempting to integrate UC recommendations, our past field observations, and conclusions reached by Campbell Soup field teams. The goal is a coherent easy-to-apply system for monitoring of late season pests including the potato aphid, stinkbugs (3-5 species), and worms (3 species).

In general, the early pest of this group is the potato aphid. We have comparative data from this season and 1994 for the UC tip sampling and our spot sampling systems. Time limitations have prevented a complete analysis to resolve conflicting recommendations to growers, but certain findings still are possible.

Discussion: The 1996 season suggested there is a definite conflict between our advice and the advice from UC extension regarding the trigger for aphid treatment. The UC tentative guidelines indicate a treatment should occur when 50% of the leaves are infested with one or more aphid. The UC sampling method is fast and simple but encourages early treatment before natural enemy populations build enough to judge whether they will suppress the population before the action level is reached. The method is useful for detecting dispersion across fields, however. It is based on the assumption that monitoring for fruitworm eggs is already being conducted. But we do not advise routine scouting for fruitworm eggs since fruitworms are more detectable in shake sample.

In contrast to the UC advice the spot sampling system we have been developing may be too complicated for growers to understand. It is fast and simple and measures both inner and outer canopy areas, something which may be proven unnecessary with further analysis. For example, only the inner canopy samples may be necessary to detect potentially damaging populations. The original design of our sampling system was based on the experiences of Dr. Harry Lange, now retired from UC, Davis, who worked with tomatoes for decades. Lange, some PCAs, and some growers commonly look into the canopy to assess aphid numbers on the lower leaves and early setting fruit. Natural enemies are also more obvious in the inner canopy. The upper leaf samples were added to the procedure in order to correspond with the UC tip samples and comparison evaluation.

We are using two measurements to indicate density (aphid/leaflet) and dispersion (% aphid positive leaves), based on leaflet samples from 12 leaves, taken from one spot, in a 40-50 ac field. Plant stress is logically based on the number of aphids per plant for a specified time period which can be determined by an assessment of both density of infested leaflets and proportion of leaflets infested.

We were using 5 aphids per leaflet as the trigger and 100% of the leaflets infested. Table 3 shows data collected with both UC and BIRC's spot sampling systems just prior to actual grower treatment. We conclude from these observations that: 1) growers are still treating too soon, 2) the UC system emphasizes early treatment and 3) the spot sampling system's treatment guidelines are too late.

We think the spot sampling system provides a better measure of potential plant stress. In uniform fields it is also superior to the UC system as it is faster, but may require multiple samples to detect hot spots. The spot sampling system measures different subpopulation spaces than the UC tip sample.

When growers use the spot sampling and decision making levels there is a greater possibility that no treatments will be needed. This is because a certain level of aphid presence is necessary to produce the natural enemies which ultimately control the excessive aphid population growth. Further work is needed to resolve these differences and to incorporate natural enemies.

Objective 3: Conduct on-farm field tests of techniques to reduce the use of toxic materials on processing tomatoes.

Seven out of 16 growers (44%) attempted some innovations that if widely adopted could substantially reduce conventional pesticide use:

- on-farm tests of alternative products, Trilogy™ (a neem oil base) or BT (Bacillus thuringiensis);
- partial field treatments with conventional products compared to no-treatments.

Objective 3a. Low-toxic selective insecticides and application methods for aphids.

Three growers treated field portions with the botanically derived registered insecticide/miticide/fungicide Trilogy® (from W.R. Grace) using donated materials. Trilogy was aimed at the potato aphid and provided adequate control in two of the fields. On one field the wrong dosage was used by the applicator by mistake. The most effective application reduced aphids by 86% on one 10 ac field.

Another application against stinkbugs was not effective and another application was improperly mixed by the applicator. Further trials with Trilogy in combination with the soap product M-Pede (Mycogen) will probably be more effective and are planned for 1997. This mixture must be applied by ground in relatively high volumes of water (30 gals/ac).

A number of other growers tried using *Bacillus thuringiensis* (Bt) for beet armyworm control. This application of Bt is important since there are no guidelines for sampling or treatment at the time when the beet armyworm occurs. Bt products do not harm the natural enemies which then prevent other pest problems from developing.

We are gaining more confidence with Bt products for use against the BAW. Use of Bt products for beet armyworm control was as effective as the conventional materials on two different applications. Grower H applied Xentari (Abbott Labs) by ground to 35 ac and grower G applied by air to 15 ac. Prespray beet armyworm counts were 2 for grower H and post count was zero. For grower G pre-counts were 20 BAW and 8 yellow striped armyworm (YSAW), while post treatment sampling found 1 BAW. Additional trials are planned for 1997. It is already known that Bt works effectively against the tomato fruitworm. Thus, Bt products could be used for beet armyworms and other worms. These products are selective, conserving existing natural enemy populations.

Discussion: Additional field trials are needed to confirm efficacy of all alternative products. To increase the possibilities of success we hope to continue field trials against aphids with a mixture of 1% Trilogy® and 1% M-Pede (Mycogen). The latter component is an insecticidal soap that is also soft on beneficials but provides additional immediate contact toxicity to aphids. More field trials with Bt products are also warranted but we expect to first reevaluate the different products now on the market to determine which has the best effects against the difficult-to-control beet armyworm.

The main pest problem remaining for which no alternative material is readily available is the stinkbugs. We think that the developping UC guidelines would be a great improvement over existing practice if growers as well as the processors would agree to using a standard sampling and decision-making system. However, actual use of sampling systems and treatment guidelines derived from small field plots need to be reconciled with actual damage levels as obtained in growers fields and what processors consider intolerable damage. Otherwise, unnecessary treatments will probably be inevitable as growers strive to produce the best looking fruit yields.

Objective 3b. Partial field treatments with conventional products compared to no-treatments.

One useful way to begin developing grower confidence is to use spot treatment as a way to reduce overall application levels. This requires an extra sampling effort, particularly when fields have uneven distributions. Stinkbugs are generally believed to be "spotty" and this maybe a way to further reduce the use of Monitor® since no alternative material is available to test.

Discussion: We have used low doses of conventional materials successfully in the past for worm control (e.g., Lannate at 1/4 lb/ac). We have begun exploring ways to sample fields for potential spot treatment of stinkbug populations. We hope to have opportunities to evaluate these methods again in 1997.

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TABLE 1 - Late Season Insecticide Treatments by Targeted Pests

Treatment Type	# Treatments	# of Treatments vs. Total # of Treatments	TARGETED INSECT PESTS-LATE SEASON			Treatments in Compliance with Working Action Level
			Aphids	Worms	Stinkbugs	
Dimethoate	4	7%				0 **
Dimethoate/Asana	20	37%				1 **
Monitor	7	13%				0
Monitor/Asana	2	4%				0
Asana	3	6%				0
Asana/Trilogy	1	2%				0
Trilogy @	2	4%				0
Trilogy/Neemix	1	2%				0
Trilogy/Bt	2	4%				1
Bt	3	6%				1
Sevin/Dimethoate	1	2%				0
Lannate	1	2%				1
No Late Insecticides	7	13%				6
TOTAL OF ALL TREATMENTS	54	100%				10

10/51 ~ 20% Compliance

* Late Season Monitoring: 1 June - 7 October

** Monitoring Data missing from fields 5, 28, and 52 - dropped

@ Experimental Treatments

† Working Action Levels: 5 aphids/leaflet, 3 stinkbugs/10 plants, 5 armyworms/10 plants

Pest targeted by grower

Monitor is labelled for worms, stinkbugs, and aphids. Growers use it primarily for stinkbugs, once for aphids and not for worms.

BIRC Processing Tomato IPM Project 1996

TABLE 2 - Last Check Pest Monitoring Data Subsequent Treatments and Yield Data by Field

ACTION LEVELS: 5 Aphids/LFLT 5 Armyworms/10 plants 3 Stinkbugs/10 plants

	Grower	Field	Acres	worm level	stinkbug level	spot aphid level	last check	Spray Date/Material	4 week pre-harvest	begin harvest	TPA - paid
1	A	B20	35	0	0	2.3 40%	15-Jul	7/19 Monitor Sulfur	21-Aug	18-Sep	36.4
2	A	A16	50	0	0	6.8 75%	22-Jul	7/24 Trilogy 7/29 Dimeth. 8/1 Dimeth. 8/17Sulfur	21-Aug	18-Sep	11.49
3	A	A17	110	0	0	0.23 5.8%	25-Jul	7/29 Monitor Sulfur	3-Sep	1-Oct	19.2
4	B	81	30	1 baw	0	0.73 10%	24-Jul	7/30 Dimethoate	13-Aug	10-Sep	24.39
5	B	88	52	0	0	no data	24-Jul	7/30 Asana Dimethoate	15-Aug	12-Sep	31.47
6	B	88	52	1 baw	0	0.2 6%	30-Jul	8/6 Asana	15-Aug	12-Sep	31.47
7	C	16	75	0	0	0.53 16%	8-Jul	7/13 Asana Dimethoate	16-Aug	13-Sep	35.5
8	D	Ber-N	78 62tr	0	0	0.17 16%	10-Jul	7/11 Asana Dimethoate	27-Aug	24-Sep	33.5
9	D	Ber-S	16	8 ys 20 baw	0	0.16 1.6%	24-Jul	7/27 Javelin	27-Aug	24-Sep	33.5
10	D	Ber-all	78	0	0	s/w- 0.6 10%	29-Jul	8/2Sulfur 9/10 Asana Ethrel			33.5
11	D	Mc-S	33 20tr	0	1	1.5 43%	12-Aug	8/13 Asana Monitor Bravo	17-Aug	14-Sep	34.42
12	D	Mc-N	33 13tr	1 baw	2	1.2 43%	21-Aug	8/22 Javelin Trilogy Bravo 8/31 Ethrel (all)	17-Aug	14-Sep	34.42
13	D	We-N	42 30tr	1 baw	13	0.04 3.3%	19-Aug	8/20 Asana Trilogy Bravo	24-Aug	21-Sep	35.4
14	D	We-S	42 12tr	1 baw	13	0.04 3.3%	19-Aug	8/22 Javelin Trilogy Bravo 9/7 Ethrel (all)	24-Aug	21-Sep	35.4
15	D	Car.4	82	0	0	0.02 1.6%	29-Jul	8/3 Agree 8/4 Asana Dimethoate Bravo	6-Aug	3-Sep	26.78
16	D	Brz.1	102	2 baw	0	0	29-Jul	8/4 Asana Dimethoate Bravo 8/14 Asana Monitor Bravo	10-Aug	7-Sep	32.46
17	D	Gre.1	33	1 baw 3 ysaw	0	0	29-Jul	8/4 Asana Dimethoate Bravo 8/15 Asana Monitor Bravo 8/21 Ethrel	9-Aug	6-Sep	32.56
18	D	Gre.2	34	1 baw	16	0.6 25%	6-Aug	8/8 Asana Monitor 8/20 Bravo 8/21 Ethrel	5-Aug	2-Sep	31.59
19	E	8	35	2 baw	4	1.2 3.3%	28-Jul	8/1 Xentari Sulfur	25-Jul	22-Aug	31.48
20	F	11	120	0	1	1.6 55%	8-Jul	7/12 Monitor			no data
21	F	11	120	0	0	0.46 10%	24-Jul	7/31 Monitor			no data
22	F	10	90	0	1	1.67 37%	22-Jul	7/31Monitor 8/9 Ethrel			no data
23	G	7	45	0	0	6.98 73%	20-Jul	7/21 Asana Dimethoate Sulfur 8/20 Bravo 8/22 Ethrel	18-Aug	15-Sep	21.6
24	H	M1	32	2 baw	0	1.18 42%	22-Jul	7/23 Asana	18-Aug	15-Sep	29.06
25	H	M1	32	2 baw	0	1.18 42%	22-Jul	8/29 Ethrel 9/13 Lannate	18-Aug	15-Sep	29.06
26	H	M2	28	0	0	4.4 48%	22-Jul	7/23 Asana Dimethoate 8/29 Ethrel 9/13 Lannate	20-Aug	17-Sep	33.86
27	H	M3	74	0	1	0.06 3%	8-Jul	7/8 Sulfur	25-Jul	22-Aug	29.54
28	H	M14B	44	0	0	no data	7-Aug	8/2 Dimethoate Sulfur 9/3 Ethrel	14-Aug	11-Sep	24.15
29	H	M14C	65	0	0	1.22 17%	15-Jul	7/28 Dimethoate Sulfur 9/3 Ethrel	14-Aug	11-Sep	24.15
30	I	605	90	0	0	0.67 21%	16-Jul	7/22 Asana/Dimeth Sulfur Ethrel	23-Jul	20-Aug	10
31	I	604	58	0	0	0.18 10%	20-Aug	8/21 Sulfur Bravo	11-Aug	8-Sep	24
32	I	603	70 12tr	0	0	2.2 47%	30-Jul	8/2 Trilogy	10-Aug	7-Sep	33
33	I	603	58	0	0	2.2 47%	30-Jul	8/3 Monitor Sulfur Bravo	10-Aug	7-Sep	35
34	I	602	17.5	1baw	0	0.48 19%	6-Aug	8/8 Asana Dimeth Sulfur 8/29 Bravo Sulfur	18-Aug	15-Sep	33
35	I	601	36	0	0	0.33 15%	9-Jul	7/13 Dimethoate 8/22 Sulfur Bravo	1-Aug	29-Aug	38
36	I	N19	11	2 baw	0	1.5 5%	30-Jul	8/4 Asana Dimethoate 8/29 Sulfur Bravo	21-Aug	18-Sep	27
37	J	Midwy	68	1 baw	0	1.7 37%	20-Aug	8/31 Asana Dimethoate	2-Sep	30-Sep	9.4
38	J	"13"	48	1 ys 8 baw	0	5 72%	20-Aug	8/24 Asana Dimethoate	15-Sep	13-Oct	23.8
39	J	"14"	75	1 baw	0	0.3 12%	30-Jul	8/1 Sulfur	30-Aug	27-Sep	22.8
40	K	29	310	0	2	0.09 6%	13-Aug	8/17 Sulfur 9/6 Ethrel	2-Aug	30-Aug	37.4
41	K	27	120	3 baw	2	0.03 2.5%	13-Aug	8/17 Sulfur	11-Aug	8-Sep	34.14
42	L	75	100	0	1	0.23 15%	24-Jul	7/25 Asana Dimethoate Sulfur 8/14 Rally Bravo 9/1 Bravo	1-Aug	29-Aug	26
43	L	70E-N	90 34tr	1 baw	2	0.05 15%	14-Aug	8/18 Monitor Rally Bravo	11-Aug	8-Sep	11.06
44	L	70E-S	10tr	1 baw	2	0.05 15%	14-Aug	8/19 Trilogy/Neemix Rally Bravo	11-Aug	8-Sep	11.06
45	M	E40	64	1 ys	0	1.13 21%	30-Jul	8/6 Sevin Sulfur Dimethoate			no data
46	N	103	69	0	0	0.2 5%	23-Jul	7/31 Asana/Dimethoate 8/24 Sulfur Bravo			no data
47	N	111	47	0	0	s: 0.1 5% n:0.4 8%	23-Jul	7/24 Sulfur 8/1 Dimethoate Asana			no data
48	N	68	60	0	0	0.65 32%	29-Jul	8/1 Dimethoate Asana	9-Aug	6-Sep	34.03
49	N	33	73	0	0	0.83 23%	29-Jul	7/30 Asana Dimethoate	9-Aug	6-Sep	32.9
50	N	15	39	0	2	.04 2.5%	6-Aug	8/9 Asana Dimethoate	29-Jul	26-Aug	26.1
51	N	6	41	0	0	0.3 12%	23-Jul	7/30 Asana Dimethoate	21-Aug	18-Sep	33.16
52	N	4	31	no data	no data	2.51 40%	30-Jul	7/30 Asana Dimethoate	25-Aug	22-Sep	24.45
53	O	8	71	2 baw	0	1.6 35%	14-Aug	8/14 Sulfur 8/28 Bravo	9-Aug	6-Sep	35.4
54	P	Q 82	136	7 baw	0	0.28 12%	7-Aug	8/8 Sulfur			no data

Table 3 - Processing Tomatoes - 1996 Aphid Spot Samples (BIRC Method) and U.C. Method

	Grower	Field	Acres	date of check	upper plant		lower plant		combined upper + lower		U. C.	Late Season Spray Date/material
					aphids/leaf	leaves infested	aphids/leaf	leaves infested	aphids/leaf	leaves infested		
1	Gn	Mc-N	33	12-Aug	1.86	63%	0.66	40%	1.26	51%	53%	
2	Gn	Mc-N	33	21-Aug	1.77	48%	0.61	36%	1.20	43%	46%	8/22 Javelin Trilogy
3	Gn	Mc-N	33	30-Aug	1.40	31%	0.67	32%	1.00	33%	nd	
4	Gn	Mc-N	33	3-Sep	0.13	10%	0.20	13%	0.16	12%	12%	
5	Gn	We-S	42	29-Jul	0.26	13%	0.16	10%	0.22	12%	34%	
6	Gn	We-EW	42	5-Aug	0.20	7%	0.10	8%	0.15	8%	15%	
7	Gn	We-S	42	12-Aug	1.30	37%	0.23	13%	0.80	25%	0%	
8	Gn	We-N	42	12-Aug	0.50	17%	0.80	30%	0.66	23%	0%	
9	Gn	We-E	42	19-Aug	0.00	0%	0.00	0%	0.00	0%	30%	
10	Gn	We-W	42	19-Aug	0.13	10%	0.03	3%	0.08	7%	20%	8/20 Javelin Trilogy
11	Gn	We-EW	42	26-Aug	0.10	3%	0.16	2%	0.60	3%	20%	8/22 Javelin Trilogy
12	Gn	Gre.2 NW	34	29-Jul	0.00	0%	0.20	7%	0.08	3%	nd	
13	Gn	Gre.2 N	34	6-Aug	0.30	23%	0.20	20%	0.25	22%	20%	
14	Gn	Gre.2 S	34	6-Aug	0.40	16%	1.30	40%	0.90	28%	43%	8/8 Asana Monitor
15	Hi	8-S	35	30-Jul	0.03	3%	0.10	10%	0.07	7%	nd	
16	Hi	8-S	35	6-Aug	0.13	10%	0.03	3%	0.08	7%	10%	
17	Hi	8-N	35	13-Aug	0.00	0%	0.10	3%	0.05	2%	7%	
18	Hi	8-S	35	13-Aug	1.20	20%	0.07	7%	0.60	13%	47%	
19	Hi	8-N	35	20-Aug	0.00	0%	0.00	0%	0.00	0%	10%	
20	Me	604-NE	58	6-Aug	3.00	60%	0.83	35%	1.90	48%	50%	
21	Me	604-N	58	13-Aug	1.90	50%	0.93	40%	1.40	45%	40%	
22	Me	604-S	58	17-Aug	3.90	70%	0.37	20%	2.10	45%	100%	
23	Me	604-N	58	17-Aug	1.40	57%	0.43	13%	0.92	35%	87%	
24	Me	604-S	58	20-Aug	0.30	17%	0.70	3%	0.20	10%	76%	8/21 Sulfur
25	Me	N19-E	11	30-Jul	8.20	90%	6.70	90%	7.50	90%	nd	
26	Me	N19-N	11	20-Aug	0.23	7%	0.06	3%	0.15	5%	27%	
27	Me	N19-S	11	27-Aug	0.23	3%	0.00	0%	0.12	2%	7%	
28	Ni	Midwy-S	68	16-Jul	0.00	0%	0.30	7%	0.15	3%	nd	
29	Ni	Midwy-S	68	27-Jul	0.27	20%	0.67	17%	0.47	18%	nd	
30	Ni	Midwy-N	68	9-Aug	0.00	0%	0.37	3%	0.20	2%	nd	
31	Ni	Midwy-S	68	13-Aug	0.30	20%	0.47	17%	0.40	18%	73%	
32	Ni	Midwy-N	68	13-Aug	1.50	30%	0.30	13%	0.60	22%	67%	
33	Ni	Midwy-N	68	18-Aug	0.20	10%	0.20	10%	0.20	10%	37%	
34	Ni	Midwy-S	68	27-Aug	0.87	37%	0.27	13%	0.56	25%	50%	
35	Ni	Midwy-N	68	27-Aug	1.20	43%	0.57	30%	0.87	37%	90%	
36	Ni	"13"-S	48	30-Jul	0.20	3%	0.03	3%	0.10	3%	20%	

Table 3 - Processing Tomatoes - 1996 Aphid Spot Samples (BIRC Method) and U.C. Method

	Grower	Field	Acres	date of check	upper plant		lower plant		combined upper + lower		U. C.	Late Season Spray Date/material
					aphids/leaf	leaves infested	aphids/leaf	leaves infested	aphids/leaf	leaves infested		
37	Ni	"13"-S	48	6-Aug	0.40	33%	1.95	47%	1.20	39%	25%	
38	Ni	"13"-S	48	13-Aug	1.20	40%	2.30	73%	1.80	57%	50%	
39	Ni	"13"-N	48	13-Aug	5.00	60%	10.00	73%	7.50	67%	76%	
40	Ni	"13"-N	48	20-Aug	2.10	47%	7.90	97%	5.00	72%	90%	8/24 Asana/Dimethoate
41	Ni	"13"-S	48	20-Aug	0.20	17%	0.07	7%	0.10	12%	30%	8/24 Asana/Dimethoate
42	Ni	"13"-S	48	27-Aug	2.40	37%	0.93	37%	1.70	37%	47%	
43	Ni	"13"-W	48	6-Sep	0.00	0%	0.03	3%	0.02	2%	7%	
44	Ni	"14"-N	75	27-Jul	0.23	7%	0.20	3%	0.10	2%	nd	
45	Ni	"14"-N	75	30-Jul	0.20	13%	0.30	10%	0.30	12%	30%	8/ll Sulfur
46	Ni	"14"-S	75	9-Aug	0.10	3%	0.00	0%	0.05	2%	nd	
47	Ni	"14"-NW	75	13-Aug	0.20	10%	0.20	13%	0.20	12%	37%	
48	Ni	"14"-NE	75	13-Aug	0.00	0%	0.03	3%	0.02	2%	13%	
49	Ni	"14"-N	75	20-Aug	0.05	5%	0.02	2%	0.03	3%	47%	
50	Ni	"14"-N	75	27-Aug	0.02	2%	0.00	0%	0.01	1%	20%	
51	Ni	"14"-N	75	6-Sep	0.00	0%	0.00	0%	0.00	0%	3%	
52	Og	29W	155	16-Jul	0.00	0%	0.10	10%	0.05	5%	nd	
53	Og	29W	155	7-Aug	0.02	2%	0.10	7%	0.06	4%	43%	
54	Og	29W	155	13-Aug	0.20	17%	0.20	10%	0.20	13%	27%	8/17 Sulfur
55	Og	29W	155	20-Aug	0.00	0%	0.00	0%	0.00	0%	36%	
56	Og	29W	155	27-Aug	0.03	20%	0.93	13%	0.23	17%	57%	
57	Og	29W	155	4-Sep	0.07	3%	0.00	0%	0.03	2%	17%	
58	Og	29W	155	11-Sep	0.00	0%	0.00	0%	0.00	0%	7%	
59	Og	27-NS	120	9-Jul	0.00	0%	0.02	2%	0.01	1%	nd	
60	Og	27	120	7-Aug	0.12	2%	0.10	3%	0.10	5%	13%	
61	Og	27	120	13-Aug	0.00	0%	0.07	5%	0.03	3%	3%	8/17 Sulfur
62	Og	27	120	20-Aug	0.00	0%	0.00	0%	0.00	0%	0%	
63	Og	27	120	27-Aug	0.00	0%	0.00	0%	0.00	0%	0%	
64	Ro	70E-N	90	2-Jul	0.20	3%	0.33	13%	0.26	8%	nd	
65	Ro	70E-N	90	8-Jul	d missing		d missing		0.96	16%	nd	
66	Ro	70E-S	90	16-Jul	0.43	20%	0.10	10%	0.27	15%	nd	
67	Ro	70E-N	90	31-Jul	0.60	17%	0.13	7%	0.37	12%	33%	
68	Ro	70E-S	90	31-Jul	0.30	3%	0.27	17%	0.15	10%	10%	
69	Ro	70E-S	90	10-Aug	0.02	2%	0.10	3%	0.05	2%	19%	
70	Ro	70E-N	90	14-Aug	0.07	7%	0.03	3%	0.41	5%	0%	8/18 Monitor
71	Ro	70E-S	90	14-Aug	0.00	0%	0.03	3%	0.02	2%	0%	8/19 Trilogy/Neemix
72	Ro	70E-S	90	19-Aug	0.00	0%	0.00	0%	0.00	0%	7%	

Table 3 - Processing Tomatoes - 1996 Aphid Spot Samples (BIRC Method) and U.C. Method

	Grower	Field	Acres	date of check	upper plant		lower plant		combined upper + lower		U. C.	Late Season Spray Date/material
					aphids/leaf	leaves infested	aphids/leaf	leaves infested	aphids/leaf	leaves infested		
73	Ro	70E-S	90	26-Aug	0.00	0%	0.00	0%	0.00	0%	10%	
74	Ro	70E-N	90	26-Aug	0.00	0%	0.00	0%	0.00	0%	0%	
75	Ti	15-S	39	30-Jul	0.03	3%	0.00	0%	0.02	2%	17%	
76	Ti	15-N	39	30-Jul	1.60	23%	0.23	10%	0.90	16%	13%	
77	Ti	15-S	39	6-Aug	0.00	0%	0.00	0%	0.00	0%	7%	
78	Ti	15-N	39	6-Aug	0.13	7%	0.03	3%	0.08	5%	53%	8/9 Asana/Dimethoate
79	Ti	15-S	39	12-Aug	0.00	0%	0.00	0%	0.00	0%	3%	
80	Ti	15-N	39	12-Aug	0.66	3%	0.00	0%	0.03	2%	7%	
81	Ti	15-NS	39	21-Aug	0.00	0%	0.00	0%	0.00	0%	0%	
82	Ti	15-S	39	26-Aug	0.00	0%	0.00	0%	0.00	0%	nd	
83	Ti	15-N	39	26-Aug	0.00	0%	0.30	3%	0.02	2%	nd	
84	Tu	8-N	71	2-Jul	0.00	0%	0.30	7%	0.20	3%	nd	
85	Tu	8-N	71	16-Jul	0.30	3%	4.00	17%	2.13	10%	nd	
86	Tu	8-N	71	22-Jul	0.00	0%	0.00	0%	0.00	0%	nd	
87	Tu	8-N	71	31-Jul	0.00	0%	0.90	20%	0.40	10%	nd	
88	Tu	8-S	71	31-Jul	1.20	34%	0.20	17%	0.70	27%	40%	
89	Tu	8-S	71	5-Aug	0.20	13%	0.10	7%	0.15	10%	7%	
90	Tu	8-N	71	5-Aug	1.00	10%	0.70	33%	0.90	22%	47%	
91	Tu	8-S	71	14-Aug	0.00	0%	0.00	0%	0.00	0%	0%	
92	Tu	8-N	71	14-Aug	1.40	47%	0.40	23%	1.60	35%	43%	8/14 Sulfur
93	Tu	8-S	71	21-Aug	0.00	0%	0.00	0%	0.00	0%	7%	
94	Tu	8-N	71	21-Aug	0.33	23%	0.10	10%	0.20	17%	23%	
95	Tu	8-S	71	27-Aug	0.20	13%	0.06	3%	0.10	8%	43%	
96	Tu	8-N	71	27-Aug	0.00	0%	0.00	0%	0.00	0%	17%	
97	Tu	8-S	71	12-Sep	0.00	0%	0.00	0%	0.00	0%	0%	
98	Ye	Q 82-S	136	23-Jul	0.00	0%	0.00	0%	0.00	0%	nd	
99	Ye	Q 82-S	136	7-Aug	0.30	17%	0.23	7%	0.27	12%	10%	8/8 Sulfur
100	Ye	Q 82-S	136	13-Aug	0.00	0%	0.00	0%	0.00	0%	17%	
101	Ye	Q 82-N	136	13-Aug	0.00	0%	0.03	3%	0.02	2%	3%	
102	Ye	Q 82-NS	136	20-Aug	0.00	0%	0.00	0%	0.00	0%	5%	
103	Ye	Q 82-NS	136	27-Aug	0.00	0%	0.00	0%	0.00	0%	5%	